

Claims

- [c1] 1. A method of designing a manufacturing process line, comprising:
- identifying a manufacturing process comprising a set of discrete steps to be performed on at least one work-piece;
 - identifying a plurality of standardized work cells, each work cell having at least one standardized workpiece presenter that supports the workpiece in a predefined spacial orientation, and at least one standardized processing tool;
 - selecting a subset of the set of discrete steps to be performed at a work cell and selecting the standardized work cell for performing the subset of steps; and
 - repeating the selecting step for additional subsets of steps to the plurality of work cells until all of the discrete steps are assigned to one of the plurality of work cells.
- [c2] 2. The method of claim 1 wherein a plurality of manufacturing process lines are identified as templates.
- [c3] 3. The method of claim 2 wherein the manufacturing process line is completely designed by specifying a plurality of templates in a defined sequence.

- [c4] 4. The method of claim 1 wherein the workpiece presenter and processing tool are interrelated with an integrated standard control system.
- [c5] 5. The method of claim 1 wherein a first work cell comprises the standardized workpiece presenter comprising a table top fixture having a tilt platform and the predefined processing tool is selected from the group consisting essentially of a welder and a gripper.
- [c6] 6. The method of claim 5 wherein a second work cell comprises the standardized workpiece presenter comprising a hexapod manipulator having six computer controlled ball screws and the processing tool is selected from the group consisting essentially of a pedestal welder, a sealant dispensing unit, and a projection weld gun.
- [c7] 7. The method of claim 6 wherein a third work cell comprises the standardized workpiece presenter comprising a pedestal welding work cell having a robotic arm for picking up parts from a fixture and moving the parts to the processing tool selected from the group consisting essentially of a pedestal welder, a sealant dispensing unit, and a projection weld gun.
- [c8] 8. The method of claim 7 wherein a fourth work cell

comprises the standardized workpiece presenter comprising a dual station having a seventh axis slide and the processing tool is a welding gun.

[c9] 9. The method of claim 8 wherein a fifth work cell comprises the standardized workpiece presenter comprising a multiple sided trunnion fixture having a plurality of fixtures for a plurality of workpieces that are rotated about a horizontal axis and the processing tool is selected from the group consisting essentially of a welding robot and a sealant applicator.

[c10] 10. The method of claim 9 wherein a sixth work cell comprises the standardized workpiece presenter comprising a multiple sided turntable fixture having a plurality of fixtures for a plurality of workpieces that are rotated about vertical axis and the processing tool is a robotic welder.

[c11] 11. The method of claim 10 wherein a seventh work cell comprises the standardized workpiece presenter comprising an indexing shuttle having at least two independently controlled fixtures for at least two workpieces and the processing tool is selected from the group consisting essentially of a welding robot and a sealant applicator.

[c12] 12. The method of claim 11 wherein an eighth work cell

comprises the standardized workpiece presenter comprising a roller bed for supporting a pallet that supports a fixture for a workpiece and the processing tool is a laser welding robot.

[c13] 13. The method of claim 12 wherein the ninth work cell comprises the standardized workpiece presenter comprising a fixture in a press welding fixture and the processing tool is a press welding fixture.

[c14] 14. The method of claim 13 wherein a tenth work cell comprises the standardized workpiece presenter comprising a fixture in a tool, and the processing tool is selected from the group consisting essentially of a hemming tool, a clinching tool, and a piercing tool.

[c15] 15. The method of claim 14 wherein an eleventh work cell comprises the standardized workpiece presenter comprising a sliding tool plate on an indexing shuttle and the processing tool is a plurality of tools selected from the group consisting essentially of a welding robot, a material handling robot, a sealant dispenser, and an adhesive dispenser.

[c16] 16. The method of claim 15 wherein a twelfth work cell comprises the standardized workpiece presenter comprising a pallet that is received on a roller bed and the

processing tool is a plurality of tools selected from the group consisting essentially of a welding robot, a material handling robot, a sealant dispenser, and an adhesive dispenser.

[c17] 17. The method of claim 16 wherein a thirteenth work cell comprises the standardized workpiece presenter comprising a pallet and the processing tool is a vision work cell having optical measuring devices.

[c18] 18. The method of claim 17 wherein a fourteenth work cell comprises the standardized workpiece presenter comprising a shuttling tooling plate mounted on a shuttle drive and the processing tool is a sealant applicator.

[c19] 19. The method of claim 18 wherein a fifteenth work cell comprises the standardized workpiece presenter comprising a pallet that is received on a roller bed and the processing tool is a welding robot.

[c20] 20. The method of claim 19 wherein a sixteenth work cell comprises the standardized workpiece presenter comprising a framer for joining a vehicle body side to an underbody that is mounted on a pallet on a roller bed and the processing tool is a welding gate fixture.